

## **Full Length Research**

# **Awareness Assessment of Hazardous Activities and Effects on Market Fire in Nigeria**

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This research investigated the human awareness of hazardous activities and its effects on market fire in Nigeria. Three (3) main markets with high commercial activities selected for this study include Tejuosho market in Lagos, Mile 1 market in Port Harcourt and Ochanja market in Onitsha. Ten hazardous activities were identified within these selected markets. Methods for information gathering include interview, literature review, questionnaire, Occupational Health and Safety Standards (OHSAS) risk estimating procedures and statistical analysis tools. Results showed that human awareness of safety rules has significant effects on the annual level of market fire incident in Nigeria. Analysis of these hazardous activities indicated maximum risk score of 3000 and minimum of 9 for different risk consequences. The relationship of risks to fire incidents were directly proportional indicating that risk at 100, 200, 500, 1000, 2000, and 3000 results in 55, 109, 293, 545, 1090 and 1637 incidents respectively. Test of significance (t-statistics) from risk scores caused by hazardous activities at s=100 (major accidents) and s=40 (few accidents) indicated great significant. The study concluded that market fire incidents will significantly be reduced annually if the frequency of hazardous activities were reduced or totally avoided. The researchers recommended the need for fire Professionals to enlighten traders on proper management of hazardous activities before setting up active and passive tools for fire prevention and control.

**Key words:** Awareness, Market, Fire, Hazards, Risk analysis.

## **INTRODUCTION**

Nigeria markets have suffered a lot of losses from fire. Fire incidences have been recorded for both low and high population markets as follows; Bernin Kebbi central market fire on March 30, 2016; Nnewi timber market on January 8, 2017 (NANT, 2016; NAN, 2016) and the list goes on and on. Improper use and handling of fire related components has led

to several fire accidents in homes, offices and other public places (Addai et al., 2011). Market fire incidents are of much interest to any nation because losses from it manifest shows negative results in the economy.

The Occupational Health and Safety Standards (OHSAS-1800; 2007) has laid down procedures to estimate risk from hazardous activities and categorize them into low or high risk. This study adopted this method to categorize hazardous

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activities in the market into low and high risk depending on the exposure (frequency) of such activities.

Works in the past have all attributed causes of fire to human factors which can be avoided. Anaglatey (2010) observed that the main causes of fire outbreak in Ghana are electrical factors associated with human misuse. Poorly constructed electrical circuits and fittings have also been attributed to fire causes in markets (Simpson, 2010; Boateng, 2013). Abu (2011) attributed fire outbreaks to cigarette smoking, human accidents and ignorance. He allocated as high as 15% to human ignorance which is an attribute to awareness issues. Exposure assessment as a tool to safety management has been proposed by Tulashie et al. (2016) and it is one of the major works that have suggested considering awareness because exposure to hazards is caused by humans. The United States Marine Municipal Association reported that about 15% of fire incidences are from equipment failure while the remaining 85% are linked to human behavior (RMS, 2004). The fact that fire is caused by humans is a logical reason to work on the attitudes of these humans to see the effect it will have on reducing fire incidents in the Nigeria markets.

The issues that need to be addressed, despite the inadequacy of firefighting facilities on ground are these: are the shop owners/traders aware that the hazardous activities that go on within the market can translate into fire incidence? How can we use human awareness as a tool to reduce market fire in Nigeria? In this study a risk assessment was carried out and the results were used to compare market fire incidents in Nigeria using statistical tools (descriptive statistics and t-statistics) to show insignificance of the frequencies of hazardous activities within the markets.

## MATERIALS AND METHOD

### Study area

The study areas for this study were Lagos in Lagos State, Port Harcourt in Rivers State and Onisha in Anambra State, which were selected as typical but densely populated cities with high commercial activities in Nigeria. Lagos state lies between latitude  $6^{\circ} 50'52.46''N$  -  $6^{\circ} 51'0.88''N$  and longitude  $3^{\circ} 4'51.21''E$  -  $3^{\circ} 5'34.56''E$ . Lagos state is densely

populated with over 9,000,000 people (NPC, 2016). The presence of an operational sea port has made growth of commercial activities very significant and this has explained the level of buying and selling activities in their markets.

Port Harcourt lies between latitude  $4.420N$  -  $4.421N$  and longitude  $6.416E$  -  $6.413E$ . Rivers state has a population above 5,100,000 people (NPC, 2016). The presence of a refinery, some oil companies have made growth of commercial activities very significant which is seen in its market activities.

Anambra lies on longitude  $6^{\circ} 27'11.77''N$  -  $6^{\circ} 27'15.40''N$  and longitude  $7^{\circ} 31'2.27''E$  -  $7^{\circ} 19'31.54''E$ . Anambra state has a population of above 4,100,000 people (NPC, 2010). The indigenous people are very entrepreneurial in nature and this has been evident in the large activities that go on in their markets. The markets located in these study areas are recognized for their high level commercial activities that even attract buyers and sellers from other cities and states. Figure 1 shows the map of Nigeria with location of the study areas.

## OBSERVATIONS AND RESULTS

This section covers research design/procedure and results. Details are as presented next.

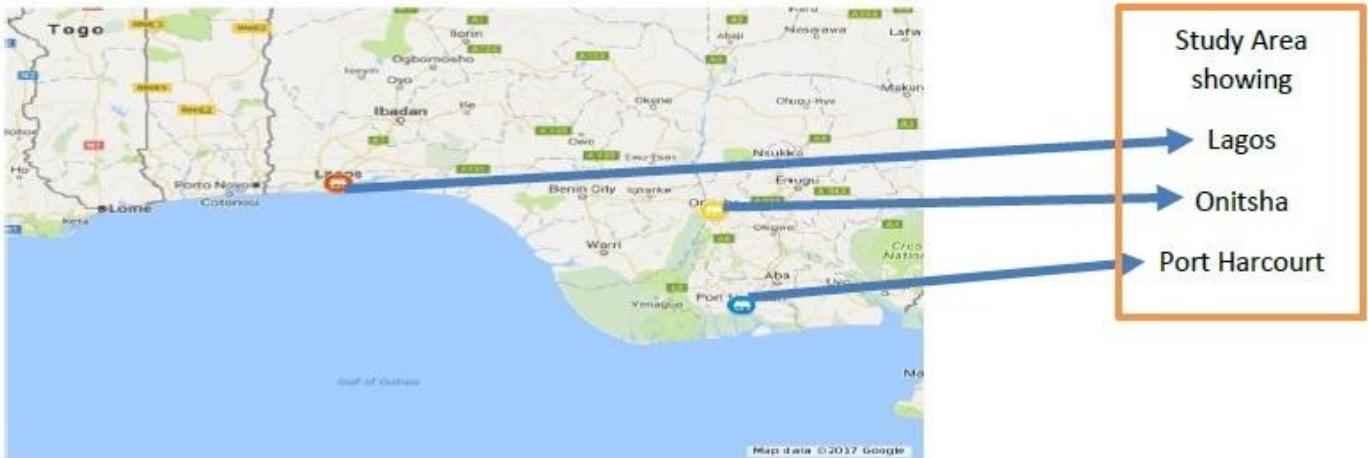
### Research Design / Procedure

Ten questions on various identified hazards were asked to shop owners/traders (See Table A1 in Appendix). Other questions such as reported cases of ongoing hazardous activities were also asked. The shop owners/traders sampled in this study cut across educated, uneducated and professionals (Figures 2 and 4). The OHSAS risk score method of risk assessment was used to score the risk of the hazards. A relationship was established between the estimated risk level and fire incidents recorded in Nigerian markets.

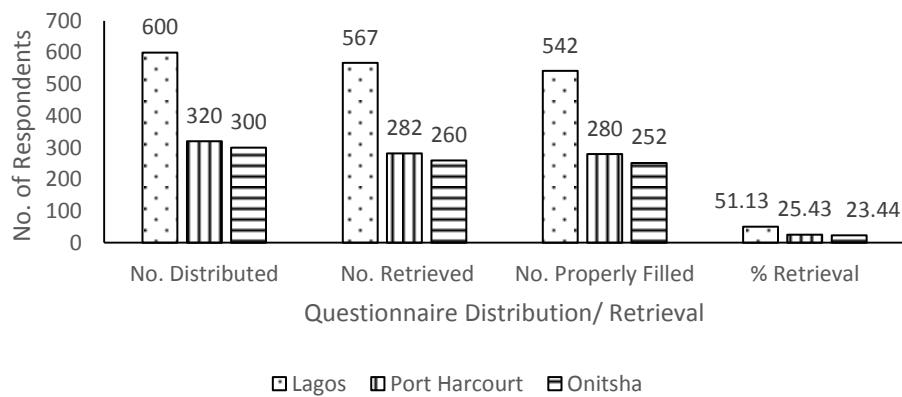
## DATA ANALYSIS

### Risk Analysis

From the risk score method (Kenney and Wiruth, 1976), Equation (1) and Tables A2-A5 in Appendix, assessment of potential hazard consequences(S),



**Figure 1.** Map showing the study locations.



**Figure 2.** Summary of Questionnaire Distribution and Retrieval Rate.

assessment of exposure to hazards (E), assessment of the likelihood (P), and Reference quality assessment of risk (R), respectively were used to estimate risk scores for the hazardous activities identified within Nigerian markets.

$$R = S \times E \times P \quad (1)$$

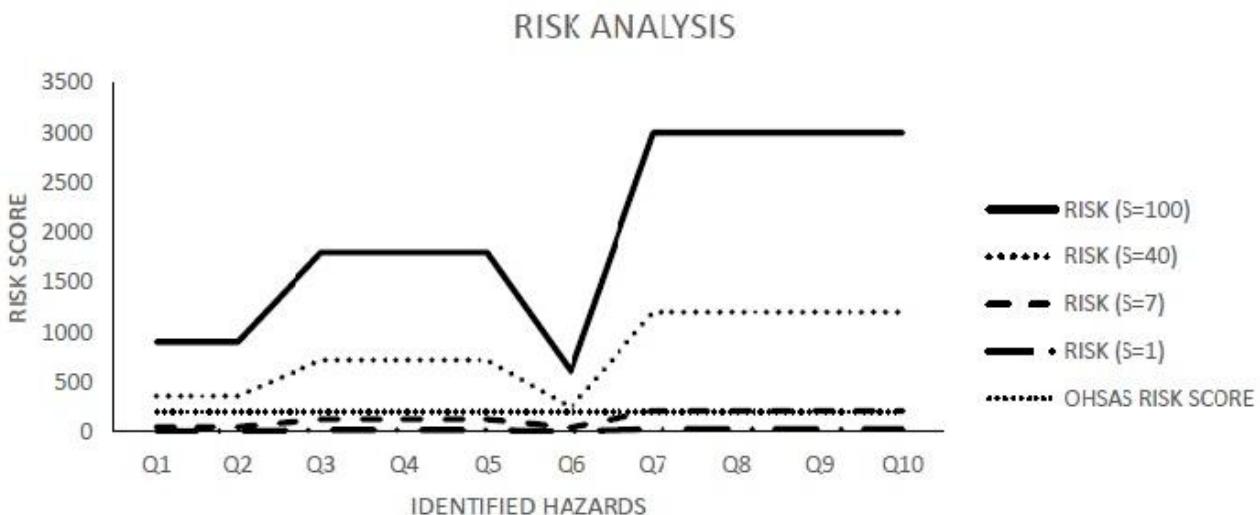
Where;

R = potential hazard consequences; E = assessment to exposure to hazard; and P = assessment of the likelihood.

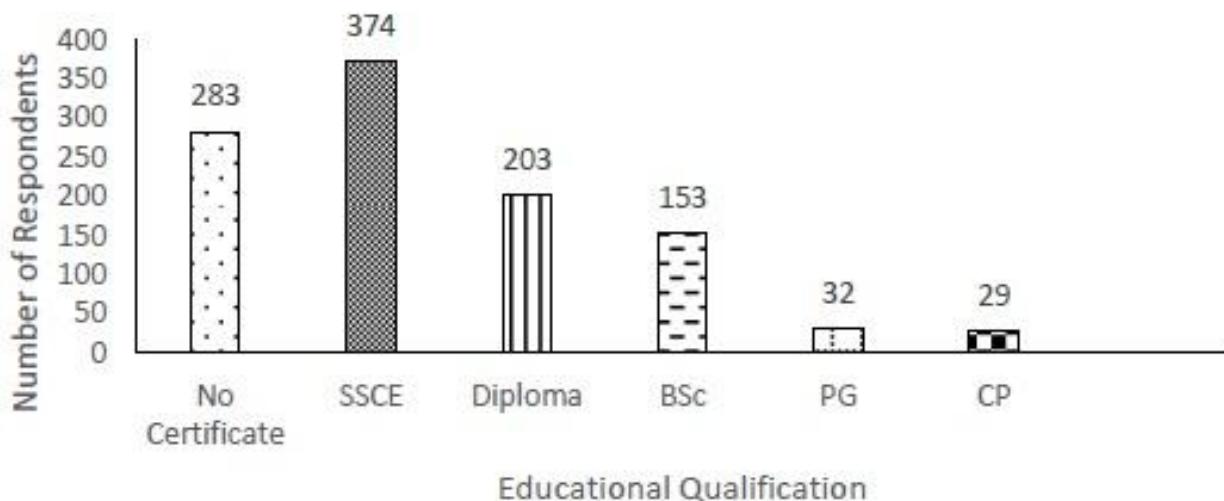
Presented in Table 1 is the response distribution of questionnaire to 1074 respondents on the frequencies of different hazards identified in the

Nigerian markets. The answers from respondents were based on the codes presented in Table A3 (see Appendix).

The assumption that the consequences of any fire breakout will always lead to many casualties was necessary for risk evaluation. The major hazardous activities in these selected markets include electrical problems, smoking in the market, storing fuel, leaving appliances switched on after business hours, burning of waste around the market, welding activities, driving and parking of vehicles, non-restaurant cooking, putting on generator sets, children playing with electrical appliances. Table 2 is presented with estimated risk scores using maximum response case for frequencies (Exposure) and a fair assumption that a fire incidence is not



**Figure 3.** Comparison between estimated risk scores and OHSAS risk level.



**Figure 4.** Categories of persons to whom questionnaire were distributed.

**Key:** SSCE = Secondary School Certificate; PG = Post Graduate (MSc); CP = Certified Professional.

likely to happen but it is possible to happen ( $P=3$ ; refer to Table A4 in Appendix). Figure 3 presents a plot showing estimated risks.

Demonstrating a sample calculation with electrical problems in the market (Question 1, i.e Q1); Table 1 shows maximum response from respondents that the activity happens once a week.

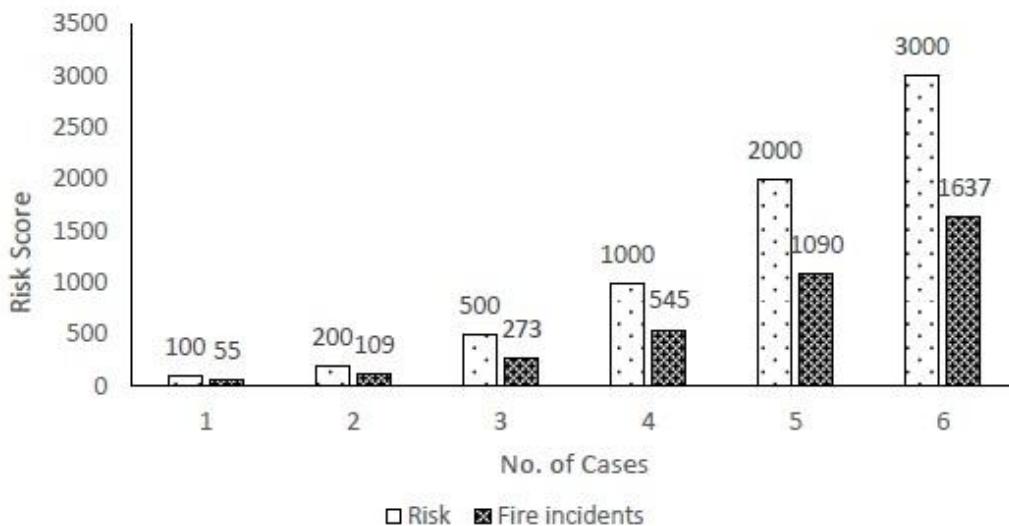
Reading up E value for hazardous activities that happens once a week gives an  $E=3$  (see Table 1).

With these value, evaluating Equation (1) yields:  

$$R = 100 \times 3 \times 3 = 300$$
 ( $S$  varies; for  $S=40$  ( $R=360$ );  $S=7$  ( $R=49$ );  $S=1$  ( $R=9$ ))

#### Descriptive Statistical Analysis

Three questions indicating market user's awareness (see Table 3) were asked respondents to see their level of awareness regarding hazardous activities



**Figure 5.** Comparative Plots of Risk to Market fire incidence.

**Table 1.** Frequency Distribution of Questionnaire Responses.

| S/N | Continuous exposure (6) | Every day (5) | Once a week (4) | Once a month (3) | Few times per year (2) | Once a year (1) | None | Total | % max |
|-----|-------------------------|---------------|-----------------|------------------|------------------------|-----------------|------|-------|-------|
| Q1  | 11                      | 186           | 734*            | 143              | 0                      | 0               | 0    | 1074  | 68    |
| Q2  | 0                       | 225           | 849*            | 0                | 0                      | 0               | 0    | 1074  | 79    |
| Q3  | 0                       | 1074*         | 0               | 0                | 0                      | 0               | 0    | 1074  | 100   |
| Q4  | 0                       | 760*          | 314             | 0                | 0                      | 0               | 0    | 1074  | 70    |
| Q5  | 0                       | 1074*         | 0               | 0                | 0                      | 0               | 0    | 1074  | 100   |
| Q6  | 0                       | 0             | 239             | 791*             | 44                     | 0               | 0    | 1074  | 74    |
| Q7  | 974*                    | 100           | 0               | 0                | 0                      | 0               | 0    | 1074  | 91    |
| Q8  | 1074*                   | 0             | 0               | 0                | 0                      | 0               | 0    | 1074  | 100   |
| Q9  | 1074*                   | 0             | 0               | 0                | 0                      | 0               | 0    | 1074  | 100   |
| Q10 | 1074*                   | 0             | 0               | 0                | 0                      | 0               | 0    | 1074  | 100   |

\*maximum response from respondents.

within the market. Secondary data collected on the level of awareness from relevant institutions in the course of this study are also presented in Table 3. This table shows the percentages of shop owners/traders that switch off their appliances, report hazardous activities and know emergency telephone numbers. From Table 3 the mean approximate level of unawareness for primary and secondary sources of data are 94.7 and 68 %, respectively.

#### Risks of Hazardous Activities versus Annual Market Fire Incidents in Markets

Using the average market fire incident of 1637 based on the records of 2013 and 2014 as 1774 and 1499 fire incidents (Federal Fire Service, 2015 and 2016), the maximum risk score 3000 from the most frequent hazardous activity (continuous exposure), Figure 5 shows predicted fire incidences estimated from a simple linear comparison.

**Table 2.** Risk scores for Hazardous activities.

| Code <sup>*</sup> | Risk Scores for Different S Values |      |     |    |
|-------------------|------------------------------------|------|-----|----|
|                   | 100                                | 40   | 7   | 1  |
| Q1                | 900                                | 360  | 49  | 9  |
| Q2                | 900                                | 360  | 49  | 9  |
| Q3                | 1800                               | 720  | 126 | 18 |
| Q4                | 1800                               | 720  | 126 | 18 |
| Q5                | 1800                               | 720  | 126 | 18 |
| Q6                | 600                                | 240  | 42  | 6  |
| Q7                | 3000                               | 1200 | 210 | 30 |
| Q8                | 3000                               | 1200 | 210 | 30 |
| Q9                | 3000                               | 1200 | 210 | 30 |
| Q10               | 3000                               | 1200 | 210 | 30 |

\*Code = Question Numbers in Questionnaire.

## TEST OF SIGNIFICANCE

With Figure 3, the annual fire incidents are read from different risk scores. We used the t- statistic to test if the reduction in consequence (S) as a result of the frequent hazardous activities has significant implications on the level of annual market fire incidents (See Table 4). The t-statistic result of comparison of risk scores caused from frequent hazardous activities with consequences as S=100 (major accidents) and that with S=40 (few accidents) showed great significance.

## DISCUSSION

This study tried to use responses from shop owners/traders and the risk score method of analysis to show that human beings unawareness contribute significantly to fire incidents in Nigerian markets. Investigator as Katarzynz et al. (2016) as proposed passive and active fire protection methods are solutions to prevent or control fire but these methods have not addressed in depth, the human factors played through the hazardous level of activities in the market environment. We believe that if the awareness within shop owners/traders is enhanced there will be remarkable reduction in the frequency of hazardous activities which in turn will reduce the fire incidents. From this study the dependency on the data collected is argued on the

fact that the respondents were distributed across all classes of shop owners/traders (See Figure 4). Thus the opinion of these shop owner/traders represent the Nigerian case as these markets have the highest recorded commercial activities and could be termed worst case scenario. The strength of data collected was based on 10 identified hazardous activities in the Nigerian market. The questions go further to ask the respondents on actions carried out when these hazardous activities were noticed and their answers showed that these activities were never reported nor addressed. That 80 % of these respondents do not know market help lines to call in an emergency and 67% do not know the need to report hazardous activities and emergencies. These values are in agreement with the responses from respondents regarding the level of awareness (See Table 3). Response from the questionnaires showed high level of frequency of hazardous activities in the Nigerian markets and the OHSAS risk score method of risk analysis was used with the assumption of different consequences to the exposure of these hazardous activities. Analyzing the risk score for each hazardous activity showed maximum risk score of 3000 and a minimum of 9 for different risk consequences (See Table 2).

A relationship of annual level of market fire incidents and risk score was carried out with the average record of market fire incidents in Lagos state in 2013 and 2014. A linear prediction method was used to estimate the expected fire incidence for other level of risks. The OHSAS high risk score limit of 200 was used to predict annual market fire incidents which resulted to an annual value of 95 incidences and this is high by the OHSAS standard. The acceptable risk by the OHSAS standard is below 200 which range from low to medium risks. With a risk score of 70 as an example the market fire incidents will reduce to an annual value of 55 fire incidents. This is to say managing the human awareness can reduce market fire incidents.

## Effects of Hazard Frequency on market Fire consequences

The frequencies of hazardous activities within the market are generally 100% attributed to human factor. As these hazardous activities are done more frequently the chances of them translating into a fire incident with different consequences is expected. As the consequences of the hazards within the market reduced it was also seen that the expected annual

**Table 3.** Respondent Level of awareness regarding activities within the markets.

| S/N | Question                                                              | % Unawareness <sup>‡</sup> |                |
|-----|-----------------------------------------------------------------------|----------------------------|----------------|
|     |                                                                       | Primary Data               | Secondary Data |
| 1   | Do shop owners/traders switch off their appliances after-market hours | 84                         | 57             |
| 2   | Do shop owners/traders report hazardous activities                    | 100                        | 67             |
| 3   | Do shop owners/traders know emergency numbers to call                 | 100                        | 80             |

<sup>‡</sup>Primary Data extracted from questionnaire response while Secondary Data are obtained from relevant Institutions.

**Table 4.** Relationship between risks varying consequences and predicted annual fire incidents.

| CODE | RISK SCORE S=100 | Predicted Annual fire incidence | RISK SCORE S=40 | Predicted Annual fire incidence | RISK SCORE S=7 | Predicted Annual fire incidence | RISK SCORE S=1 | Predicted Annual fire incidence |
|------|------------------|---------------------------------|-----------------|---------------------------------|----------------|---------------------------------|----------------|---------------------------------|
| Q1   | 900              | 491                             | 360             | 197                             | 49             | 27                              | 9              | 5                               |
| Q2   | 900              | 491                             | 360             | 197                             | 49             | 27                              | 9              | 5                               |
| Q3   | 1800             | 981                             | 720             | 393                             | 126            | 69                              | 18             | 10                              |
| Q4   | 1800             | 981                             | 720             | 393                             | 126            | 69                              | 18             | 10                              |
| Q5   | 1800             | 981                             | 720             | 393                             | 126            | 69                              | 18             | 10                              |
| Q6   | 600              | 327                             | 240             | 131                             | 42             | 23                              | 6              | 4                               |
| Q7   | 3000             | 1634                            | 1200            | 654                             | 210            | 115                             | 30             | 17                              |
| Q8   | 3000             | 1634                            | 1200            | 654                             | 210            | 115                             | 30             | 17                              |
| Q9   | 3000             | 1634                            | 1200            | 654                             | 210            | 115                             | 30             | 17                              |
| Q10  | 3000             | 1634                            | 1200            | 654                             | 210            | 115                             | 30             | 17                              |

incidents reduced. The test of significance between the consequences at S=100 and S=40 is highly significant. The implication of this is that the activities that have very severe consequences if reduced within the market will obviously reduce the number of annual fire incidents in the markets.

### An Improvement to the Existing Situation

From the analysis in this study we have tried to show that we can reduce market fire incidence by as high as 97% if the human awareness issues are seriously addressed. As the frequencies of hazardous activities with higher consequences are addressed with extreme care, then significant improvement will be seen as compared to the annual recorded market fire incidents in Nigeria. Some of the primary ways to address the awareness of shop owners/traders include:

i) Giving trainings on the do's and don'ts in the

market environment;

- ii) Giving shop owners/traders effective trainings on how to handle market facilities;
- iii) Encouraging shop owners/traders to report to authorities when they see illegal activities going on within the market; iv) Awarding some form of reward or incentive for genuine cases reported; and v) Teaching the shop owners/traders the consequences of their actions.

### CONCLUSION

Based on this study the following conclusions were reached:

- i) The hazardous activities that take place within the Nigerian markets have very high risk score as high as 15 times more than OHSAS specified limit;
- ii) Fire incidents in Nigeria markets can be

- reduced to as low as 5 incidents annually if the awareness of shop owners/traders are improved on; and
- iii) Frequency of hazardous activities also showed significant effect on the level of annual market fire incidents and the incidents will reduce significantly when the frequency of hazardous activities is reduced to once a year.

## RECOMMENDATIONS

To reduce fire incidents in Nigerian markets the following are recommended:

- i) Create awareness to the shop owners/traders and this can be done through trainings and instructions;
- ii) The frequent hazardous activities within the Nigerian markets should be reduced in order to reduce the risk of high market fire incidents;
- iii) Hazardous activities with higher consequences should be addressed with more care because these activities increase the level of annual market fire incidents.

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## APPENDIX

**Table A1.** List of questions in the questionnaire.

| Code | Question                                                             |
|------|----------------------------------------------------------------------|
| Q1   | How frequent do you have electrical problems that need attention     |
| Q2   | How frequent do people smoke in the market                           |
| Q3   | How frequent do people store fuel in their stores                    |
| Q4   | How frequent do people leave their appliances on after selling hours |

**Table A1. Contd.**

|     |                                                                                 |
|-----|---------------------------------------------------------------------------------|
| Q5  | How frequent do people burn waste around the market                             |
| Q6  | How frequent do people carry out welding activities in the market               |
| Q7  | How frequent do people drive/ park their car to restricted areas of the market  |
| Q8  | How frequent do people aside restaurants cook in the market                     |
| Q9  | How frequent do people on generators in front of their shops                    |
| Q10 | How frequent do you have children play with electrical appliances in the market |

**Table A2. Assessment of potential hazard consequences(S).**

| S value | Loss                 | Description         |
|---------|----------------------|---------------------|
|         |                      | Human loss          |
| 100     | Major accident       | Many casualties     |
| 40      | Significant accident | A few casualties    |
| 15      | Very high            | A casualty          |
| 7       | High                 | Serious injuries    |
| 3       | Medium               | Absenteeism         |
| 1       | Low                  | First aid treatment |

**Table A3. Assessment of exposure to hazard (E).**

| E value | Exposure description           | Code |
|---------|--------------------------------|------|
| 10      | Continuous exposure to hazard  | 6    |
| 6       | Frequent (every day)           | 5    |
| 3       | Sporadic (once a week)         | 4    |
| 2       | Occasional (once a month)      | 3    |
| 1       | Minimum (a few times per year) | 2    |
| 0.5     | Isolated (once a year)         | 1    |
| 0       | Never                          | NO   |

**Table A4. Assessment of the likelihood (P).**

| P value | Description                 | % of chance |
|---------|-----------------------------|-------------|
| 10      | Very likely                 | 50          |
| 6       | Likely                      | 10          |
| 3       | Not likely but possible     | 1           |
| 1       | Only sporadically possibl   | 0.1         |
| 0.5     | Possible to think of        | 0.01        |
| 0.2     | Practically impossible      | 0.001       |
| 0.1     | Only theoretically possible | 0.0001      |

**Table A5. Reference quality assessment risk (R)**

| Risk category | Value    |
|---------------|----------|
| Slight        | Below 20 |
| Low           | 20-70    |
| Medium        | 70-200   |
| High          | 200-400  |
| Very high     | Over 400 |